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Review- Using Ground Bakelite as Alternative Solution for the Replacement of Fine Aggregate

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Abstract: ***India is very fast developing nation, and construction plays vital role in developing the nation. In construction, concrete is the majorly useful material. Fine aggregate used in concrete like traditional UHPC causes several environmental issues like floods due changes the direction of river flow, effect on biological diversity, falling water table also . In current time millions of tons of waste materials disposed in open environment which causes several health as well as waste disposal problems. We can use waste material like Bakelite as the partial replacement of fine aggregate. The purpose of this study is to find whether the use of Bakelite in concrete improve its compressive strength as a partial replacement in conventional M25 grade concrete Mix. From 2010 to 2020, river sand usage in Indian construction sector increased from 630 to 1400 Tons. This type of usage is very harmful for our next generation also that's why many states in India like Bihar, Tamil Nadu, Madhya Pradesh, Rajasthan, Uttar Pradesh and Maharashtra have banned the river sand mining for use in concrete.***
Keywords: Bakelite, Fine Aggregate, Concrete Cubes, Compressive Strength, Workability.

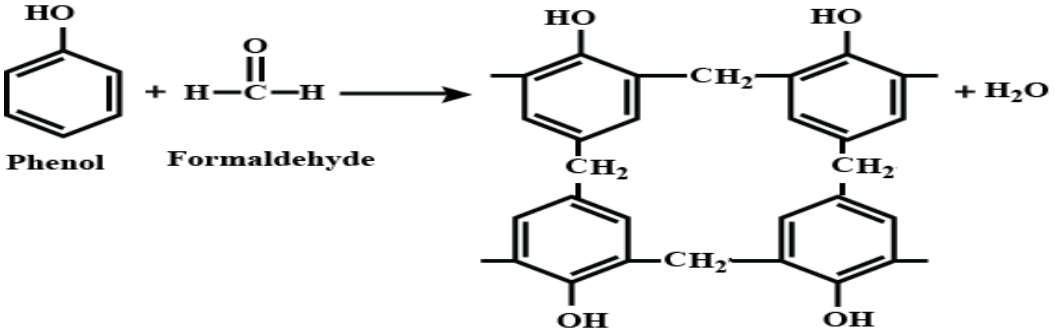
I. INTRODUCTION

Bakelite is a thermoset plastic which is formed from an poly condensation reaction of phenol with formaldehyde and it is most commonly used for Telephone casing, automobile parts, Electrical Insulators and kitchenware appliances for heat resistant [1]. The reason behind providing the heat resistance is that Bakelite cannot be remelted into another product. A Belgian- American chemist named Leo Beakeland is the one who developed the product in the year 1907 [2]. Later in December 1909, Bakelite was patented. The growth of Bakelite consumption increases Bakelite waste. Bakelite waste is prohibited from disposing of direct land filling and open burning, which becomes a waste management problem [3]. Concrete is the most widely used material in construction industry. It is understood that concrete is the second most used material after water. The purpose of this study is the use of waste Bakelite aggregate as fine aggregate to replace natural sand material partially. The objectives of the study are to determine % of fine aggregate which can be replaced by Bakelite waste without compromising the compressive strength of the conventional concrete of the grade M25, to study the effect of Bakelite waste on the slump value, compaction factor and compressive strength of the M25 grade concrete, utilization of waste Bakelite to reduce the dumping problem [3].

II. MATERIAL AND PROPERTIES

A. Bakelite

Polyoxybenzylmethylenglycolanhydride is thermosetting phenol formaldehyde resin made from the Elimination reaction of phenol and formaldehyde. And the chemical formula of Bakelite is written as $(C_6H_6O{\cdot}CH_2O)_n$. Waste Bakelite is obtained from machine parts of electrical appliance (bulb holder and wire casing), Kitchen Appliance (Handle of pressure cooker and pans) [4].



Bakelite

Table 1 Chemical composition of Bakelite

Composition (Wt%)			
Ultimate		Proximate	
Total carbon	53.4	Fixed carbon	31.70
Hydrogen	4.0	Volatiles	47.55
Oxygen	11.6	Moisture	3.01
Sulfur	0.017	Ash	17.74

Table 2 Composition of Bakelite ash (analysis done by XRF)

Compound	CaO	SiO_2	SO_3
wt.%	94.53	5.14	0.33

PHYSICAL PROPERTIES OF WBFA

PROPERTIES	WBFA(waste Bakelite fine aggregate)
Fineness Modulus	2.61
Water Absorption	6.53%
Specific Gravity	1.34(g/cm*3)
Density	894.53(kg/m+*3)

B. Fine Aggregate

Fine aggregate, which may be granular material or crushed stone, is a fundamental component of concrete. The quality of the fine aggregate and the density of the fine aggregate both have a significant impact on the hardened qualities of the concrete. The sand is of river sand screened and washed to remove all the organic and inorganic compounds that are likely to present in it. Sand has been sieved2.37mm (passed) and retained.[10]

PHYSICAL PROPERTIES OF FINE AGGREGATE:

PROPERTIES	NFA (Natural Fine Aggregate)
Fineness Modulus	3.31
Water Absorption	3.85%
Density	1680(kg/m*3)
Specific Gravity	2.65(gm/cm*3)

Comparision Between the Physical Properties of NFA and WBFA:

Aggregate Properties	NFA	WBFA
Fineness Modulus	3.31	2.61
Specific Gravity	2.65 gm/cm*3	1.34 gm/cm*3
Water Absorption	3.85%	6.53%
Density	1680 kg/m*3	894.53 kg/m*3

III. LITERATURE REVIEW

1) RR Bhopi and M Sinha partially replace the fine aggregate with Bakelite. The experimental investigation are when the percentage of Bakelite is increased the value of slump decreases. There is a decrease in the compaction factor when we increase the Bakelite percentage. We can replace the fine aggregate upto20% with Bakelite waste by weight in the concrete of M25 grade without compromising compressive strength. As the percentage of Bakelite is increased the concrete becomes lighter in weight.

2) Akhil Verma Determine strength of concrete cubes using Bakelite powder instead of natural sand. The optimum result is found to be after replacement of Bakelite powder Strength of concrete with Bakelite powder replacements at optimum ratio was tested to be 24.51 MPa 4. This concrete can be used up to 3 floor house/buildings, surface water tanks and for structure of aesthetic value. High quality control with respect to material and casting is required for this type of concrete manufactures.
3) L Arun Raja and P Kumar Study on Flexural Behaviour of Concrete by Partially Replacing Fine Aggregate with E-Plastic Waste. It is also concluded that the use of industrial wastes such as E-Plastic waste in concrete provides some advantages, like reduction in the use of natural resources, disposal of wastes, prevention of environmental pollution and energy saving.
4) Gyandeep Gupta, Mr. Rajneesh Partial Use of Bakelite Powder in Concrete Structures as an Alternative to Natural Sand. Partial Use of Bakelite Powder in Concrete Structures as an Alternative to Natural Sand at 20% replacement of natural sand with Bakelite powder the compressive strength of the concrete decreases but it is still better from the normal M25 concrete with 0% replacement, but at 30% replacement the compressive strength 9f the concrete is below 25Mpa so we can replace the sand with Bakelite powder to an extent of 20% only. The range of replacement of natural sand with Bakelite powder should be between 5% to 20% in which maximum compressive strength is obtained at 15% replacement.
5) S. Sakthi Sasmitha, Dr. R.N Uma A Critical Review on the Application of Bakelite as a Partial Replacement of Fine and Coarse Aggregate. The present study reveals the properties and use of Bakelite as a construction material in Cement, and solid blocks with appropriate specifications. The use of waste material into construction industry creates a challenging job and better performance along with the development of construction sector. Incorporation of plastic waste in building material gives a cost effective and light weight sustainable component in construction which alters the strength and durability property. This study helps to develop a replaceable material (waste Bakelite) for fine and coarse aggregate in order to minimize disposal of plastics which creates a waste management problem.

IV. CONCLUSION

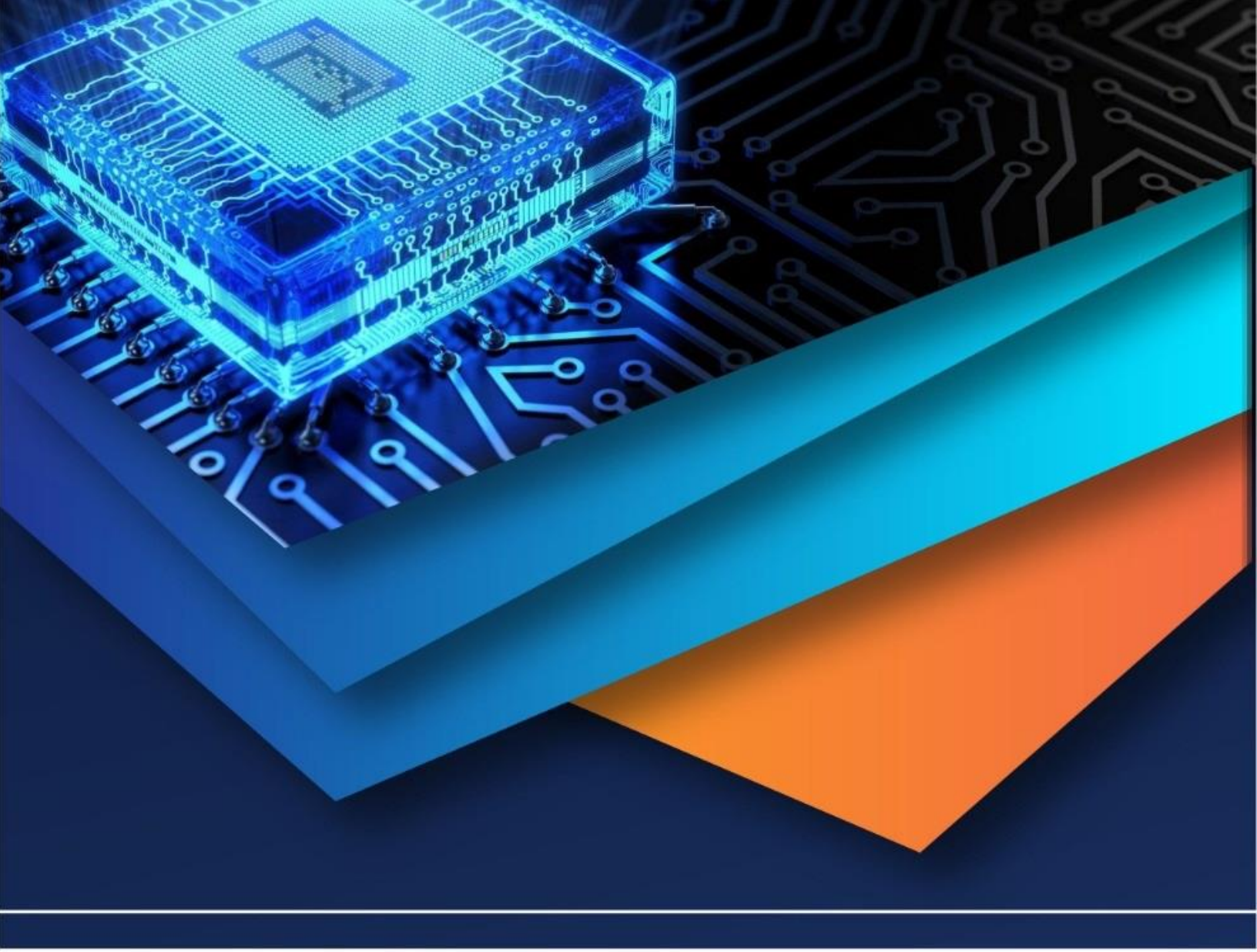
The conclusions can be drawn from the experimental investigation are when the percentage of Bakelite is increased the value of slump decreases. There is a decrease in the compaction factor when we increase the Bakelite percentage. The compressive strength of the concrete increases from 25.2Mpa to a maximum compressive strength of 27.4Mpa at the 15% replacement of natural sand with Bakelite powder. It is also concluded that the use of industrial waste such as Bakelite in concrete provides some advantages like reduction in use of fine aggregate, disposal of wastage prevention of environmental pollution. We can replace the fine aggregate Upto20% with Bakelite waste by weight in the concrete of M25 grade without compromising compressive strength. As the percentage of Bakelite is increased the concrete becomes lighter in weight. Strength of concrete with Bakelite powder replacements at optimum ratio was tested to be 225.2 MPa. This concrete can be used up to 3 floor house/buildings, surface water tanks and for structure of aesthetic value. This type of concrete mix is not ideal for high rise buildings and heavy structures.

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